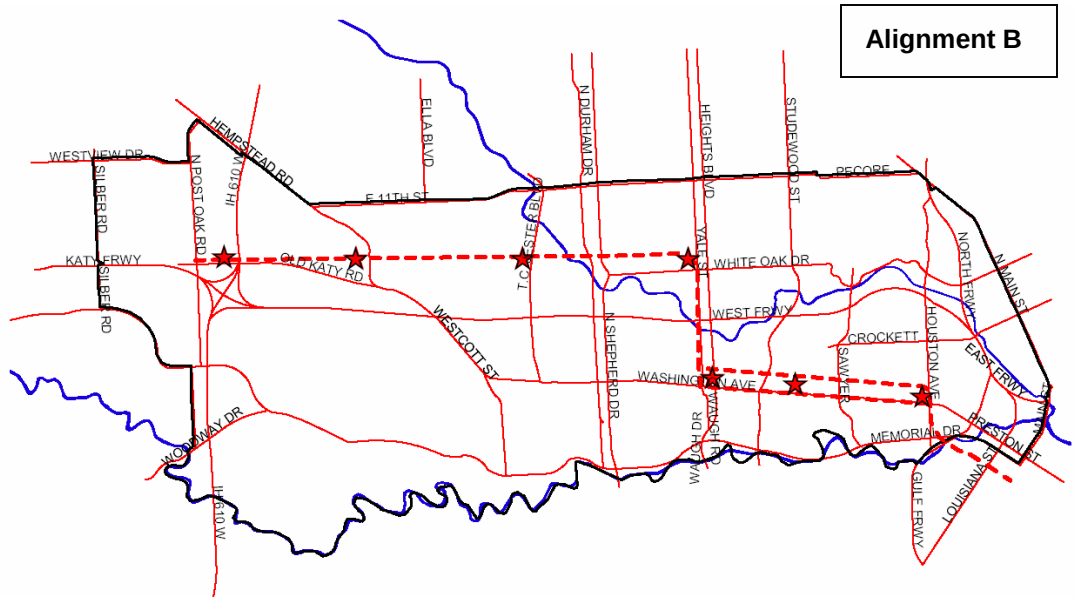
Chapter 7:
Preferred Scenario & Implementation

The Preferred Scenario and Implementation chapter includes three key elements as the final piece of the Inner Katy Transit-Oriented Development (TOD) Study: (1) selection of an optimal transit alignment and mode, (2) selection of a final TOD scenario, and (3) discussion of implementation and funding strategies for achieving the desired scenario. The chapter draws upon the information and findings of previous chapters to offer justification for the final study recommendations presented here and in Chapter 1.

Chapter Highlights

Transit Alignment and Mode

- While a majority of the project Steering Committee expressed a preference for Alignment C during the course of the study, the technical analysis in this final chapter points toward Alignment B as the optimal choice for potential high-capacity transit (HCT) across the Inner Katy area based on technical feasibility and ridership considerations (estimated 9,400 daily riders versus 3,900 on Alignment C).



- Alignment C is not ruled out as a potential transit corridor but is considered to have more feasibility challenges and practical difficulties to overcome compared to Alignment B.
- Among the two HCT mode options most closely considered for Inner Katy (heavy rail, commuter rail and automated guideway were ruled out early in the study), light rail transit (LRT) was preferred over bus rapid transit (BRT) by a majority of the project Steering Committee. Technical considerations in this chapter also showed that LRT may be warranted for Inner Katy.

Transit-Oriented Development (TOD) involves small areas with a mixture of compatible land uses and a direct linkage to transit, the combination of which encourages more walking and transit use.

High-Capacity Transit involves faster and more frequent service, longer service hours each day, and two-directional service in the same corridor versus traditional one-way service types.

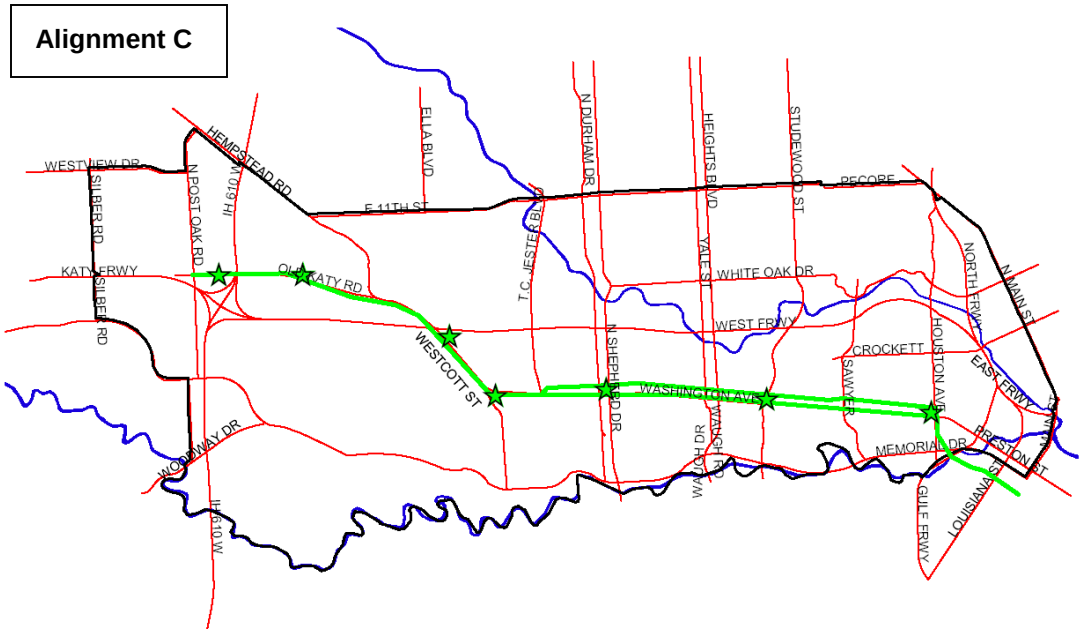
NOTE: During the course of the study, Alignment B was adjusted to shift the turning point along Yale from 7th to 6th Street. The portion west of Shepherd-Durham returns to the 7th Street alignment.

Light Rail Transit (LRT) is typically powered by an overhead electric line. LRT can operate in mixed traffic, alongside vehicles, or in its own exclusive right-of-way.

Bus Rapid Transit (BRT) describes a variety of rubber tire, high-capacity transit modes. BRT can operate in exclusive busways, in High Occupancy Vehicle (HOV) lanes, or in dedicated lanes on arterial streets.

- Inner Katy will be a critical link in any proposed regional HCT system given its position between downtown and other potential transit corridors and major activity centers to the west and northwest. If the overall HCT system is focused on LRT, then this will be the logical mode for Inner Katy, subject to detailed feasibility and design evaluation.

Alignment C



- Either mode could be constructed in either of the alignments depending on the availability of funds to overcome certain obstacles, such as bayou crossings, necessary grade separations, and acquiring additional right-of-way in key locations to provide adequate turning radius.
- In general, BRT is significantly less expensive to develop than LRT and usually less expensive to operate.
- Given the current status of transit technologies, BRT and LRT are both compatible with transit-oriented development and the land use patterns TOD creates.
- Alignment C would have a greater adverse impact on area traffic flow and would also require special design to reduce traffic impacts around the planned Washington-on-Westcott roundabout.
- METRO estimates that its initial LRT line between downtown and Reliant Park will operate at an average speed of 17 miles per hour in mixed traffic. Alignment C would operate in a similar mixed-traffic environment. Alignment B may achieve a slightly higher speed due its use of existing rail right-of-way for a portion of its length.

- Strong opportunities exist on both alignments for intermodal connections between high-capacity transit and bicycle and pedestrian routes. Both alignments also offer significant opportunities for connections to other METRO services.
- While Alignment B currently has fewer pedestrian amenities than C, pedestrian facilities will be needed along either alignment if HCT is constructed.
- In terms of neighborhood impact, Alignment B may affect Inner Katy neighborhoods and businesses to a lesser degree than would Alignment C. An advantage of Alignment B, in terms of minimized disruption and a "cleaner slate" for significant redevelopment, is that it passes through many areas (along the MKT rail line) that are still largely underutilized.
- The typical planning process in advance of a significant transit investment can take more than 10 years, as illustrated in Figure 7.3, although there are ways to accelerate this schedule.

Transit-Oriented Development Scenarios

- After two alternative development scenarios were prepared for each HCT alignment in Chapter 5, this chapter focuses on a final TOD scenario for each (presented in Figures 7.1 for Alignment C and 7.2 for Alignment B).
- Because Alignment B was the optimal choice based on transit feasibility considerations, this chapter centers mostly on the final development scenario for Alignment B. However, both the B and C final scenarios apply the concepts of transit-oriented development and show, in a strictly conceptual fashion, how Inner Katy neighborhoods could transform and develop with the addition of a light rail line and strategically-placed stations.
- Both the B and C scenarios propose seven transit stations, approximately one mile apart. This spacing permits a high level of accessibility to light rail within Inner Katy but does not significantly slow travel times for through passengers, which was a key issue throughout the study process.
- The Alignment B scenario offers: (1) an assortment of high-rise, mixed-use transit centers, plazas, pedestrian shopping districts and a waterfront park; (2) opportunities for walkable shopping and business districts; and, (3) development of an open space and trail system along White Oak Bayou, with various plazas and civic spaces acting as gateways to the greenway where it meets transit stations and adjacent development.

Implementation Strategies

- This section outlines physical design, economic development, and transit system planning considerations that will factor into successful TOD implementation in Inner Katy. In particular, a three-pronged approach to achieving pedestrian-friendly districts is recommended, involving a combination of regulation, public infrastructure investments, and public/private partnerships.

- A design preference survey conducted toward the end of the study helped the consultant team create preliminary sketch images depicting corridor redevelopment opportunities. The Steering Committee's design preferences were consistent with the four key elements in "placemaking": (1) Accessibility, (2) Activities, (3) Comfort, and (4) Sociability.
- Four additional design objectives for transit-oriented development are discussed: (1) Walking and Transit Use Go Hand in Hand; (2) Density Alone is not Good Enough (Design Matters); (3) Parking Arrangements Must Encourage Walking; and, (4) People are the Key.
- Beyond this study, it was anticipated that METRO would complete its own assessment of Inner Katy transit needs by February 2003, incorporate its Inner Katy strategy into the overall *METRO Mobility 2025* plan (scheduled for adoption in July 2003), and then initiate a detailed Inner Katy Corridor Review in August 2003.

Transit Funding Options

- Numerous funding options exist for public transportation improvements in the Inner Katy area, as catalogued in the Appendix to this chapter. These options include federal, state and local government funding as well as various forms of public/private partnerships, special district/assessment approaches, and other innovative methods to leverage public and private resources.

Further detail on the final HCT and redevelopment scenarios for the Inner Katy area are presented in the remainder of this chapter.

Final Transit Alignment and Mode

Potential High-Capacity Transit Alignments

Two potential HCT alignments – Alignments B and C – were identified during the Baseline Opportunities Analysis and Alternative Development Scenarios phase of the study. Below is a recap of their respective features and relevant considerations:

Alignment B

- **Available Right-of-Way:** Right-of-way along the 7th Street portion of the alignment is already owned by the Texas Department of Transportation and is of adequate width for much of the alignment. The north-south Yale segment also follows past rail right-of-way; however, some is in private ownership and is used for business access. The use of existing right-of-way could facilitate higher speeds compared to alignments operating in mixed traffic.
- **Washington Avenue Space Limitations:** Portions of Washington Avenue narrow to 70 feet with zero- or limited-setback buildings. The limited right-of-way creates a challenge to the ability to provide transit, automobile travel and turning lanes, bikeways and sidewalks. Therefore,

shifting one direction of the alignment north to the existing rail line and implementing one-way pair operation was suggested by some Steering Committee members. However, this is an unlikely scenario as it would involve moving a high-capacity transit line to even narrower local streets that are lined with existing residential homes in places. In addition, splitting the lines would likely boost construction costs because associated infrastructure and wiring would be needed along two separate corridors versus in a single, shared corridor. At each planned stop, separate stations would also be required, several blocks apart, to serve each direction of the split lines. These factors and other expected operational difficulties led METRO representatives to emphasize the very low likelihood of their agency ever designing or constructing a two-way transit alignment in this fashion. The impetus for transit-oriented development would also be diminished somewhat if transit riders and activity are dispersed to smaller stations.

- **Bayou Crossings and Flooding:** The alignment crosses White Oak Bayou in two places, which could require bridge construction or reconstruction or create floodplain and environmental issues. Flooding potential around Buffalo Bayou where the alignment enters downtown could also be an issue.
- **Alignment Turns:** The alignment also includes two very sharp turns – at Yale and 7th (later shifted to 6th) and at Washington and Yale. Existing development in these areas poses operational difficulties such as reduced speed.
- **Development Potential and Impact:** Older industrial sites along the alignment offer outstanding redevelopment potential. The alignment avoids the Houston Heights historic area but comes very near the Old Sixth Ward; the community has voiced concerns about negative impacts to its historical resources.
- **Station Locations:** During the Small Group Development Scenarios Workshop, participants selected potential station sites. Stations were later refined based upon Steering Committee input and economic development potential. Seven potential station locations were ultimately identified along Alignment B:

  1. North side of MKT rail line near Northwest Transit Center
  2. MKT rail line near Washington/Hempstead/Old Katy
  3. MKT rail line just west of T. C. Jester
  4. 7th and Yale (which will shift to 6th and Yale under the revised alignment turn at 6th rather than 7th Street)
  5. Between Washington and Allen, just east of Yale
  6. Between Washington and Allen near Glenwood Cemetery
  7. Between Washington and Allen at Houston Avenue

Alignment C

- **Washington Avenue Space Limitations:** Alignment C involves the same space concerns along Washington Avenue as does Alignment B, which prompted some to suggest a one-way pair operating arrangement by shifting one direction of the alignment north to the existing rail line parallel to Washington Avenue. However, as outlined above for Alignment B, this scenario has various negative aspects and would likely not be pursued by METRO.
- **Development Potential and Impact:** Washington Avenue is the historical transit and commercial corridor for Inner Katy. Redevelopment in the Washington Avenue corridor is ongoing, with the number of new commercial and multi-family residential properties growing quickly. The area is also developing as an entertainment destination. This growth could help to support the HCT line. The alignment could also provide access to Memorial Park.
- **Alignment Constraints:** Like Alignment B, flooding potential around Buffalo Bayou could be an issue. The alignment does not cross White Oak Bayou. However, it passes the planned Washington-on-Westcott roundabout, a feature of great importance to the community. Special engineering considerations (such as cut-and-cover, aerial, or underground) would be required at this location.
- **Station Locations:** During the Small Group Development Scenarios Workshop, participants selected potential station sites. Stations were later refined based upon Steering Committee input and economic development potential. Seven potential station locations were ultimately identified along Alignment C:

  1. Northwest Transit Center
  2. MKT rail line near Washington/Hempstead/Old Katy
  3. On Washington just south of I-10 near Stillman/Park Entrance
  4. Near Washington-on-Westcott roundabout
  5. Between Washington and Allen and Shepherd and Durham
  6. Between Washington and Allen near Studemont
  7. Between Washington and Allen at Houston Avenue

Cut-and-Cover is a tunneling method that consists of excavating the terrain from ground level, placing a structure in the excavation, and then filling over the structure.

Potential Transit Modes

Five high-capacity transit (HCT) modes were considered for Inner Katy:

- **Heavy Rail.** Subway systems such as those in New York, Chicago and Los Angeles are the most commonly known types of heavy rail (HR). Heavy rail is powered by an electrified third rail. The mode provides high-speed service,

operating in a dedicated right-of-way, typically in urban areas with very high population density (greater than 10,000 persons per square mile). Heavy rail requires a high initial capital investment – between $250-$350 million per mile for infrastructure plus the cost of vehicles.

- **Commuter Rail.** Commuter rail (CR) such as the Trinity Railway Express, operating between Dallas and Fort Worth, is usually powered by diesel or electric locomotives. The mode provides long-haul, high-speed service between activity centers and suburban areas, with stations 2-5 miles apart. Commuter rail most often uses existing freight rail lines and shares right-of-way with freight rail carriers. The capital investment required for commuter rail equals the cost of upgrading freight rail tracks to the standards required for passenger rail service plus the cost of locomotives and passenger cars.

- **Automated Guideway.** Automated guideway transit (AGT) includes technologies such as monorail, like that at Disney World in Florida, and the people mover systems often used at airports. AGT is usually driverless, operating on an elevated electrified guideway above a right-of-way. It typically provides point-to-point service or circulation within major activity centers (such as in Seattle's Central Business District). A current monorail construction project in Las Vegas is estimated at approximately $80 million per mile.

- **Light Rail.** Light rail (LRT), such as that in Dallas and what is now being constructed in Houston along Main Street, is powered by an overhead electric line. Light rail can operate in mixed traffic, alongside vehicles, or in its own exclusive right-of-way. The mode serves areas with densities of greater than 3,500 persons per square mile, with stations spaced about 1-2 miles apart. Light rail requires a high initial capital investment of $30-40 million per mile plus the cost of vehicles. The typical METRO right-of-way requirement for bi-directional LRT is 50 feet.

- **Bus Rapid Transit.** Bus rapid transit (BRT) describes a variety of rubber tire, high-capacity transit modes. BRT can operate in exclusive busways, in High Occupancy Vehicle (HOV) lanes, or in dedicated lanes on arterial streets. Bus rapid transit typically has features such as traffic signal priority,

fare collection improvements, limited stops, improved stations and station amenities, clean-fueled quiet vehicles, and Intelligent Transportation System (ITS) improvements. BRT is flexible in that even if it is operating in an exclusive right-of-way, it can leave the right-of-way to provide a circulation function or in the event of an emergency. BRT can also be implemented in phases, meaning that capital investment in improvements can be made over time rather than investment being required all at once. Initial capital investment varies depending on the type of operation (busway, HOV, arterial). However, BRT capital expenses are typically lower than those of other high-capacity modes. The typical right-of-way requirement for bi-directional BRT is 30 feet.

Initial Mode Screening

To narrow the range of modes under consideration, each of the five high-capacity modes was screened using four criteria:

1. **Density.** Density includes both population density and employment density. To support a high-capacity transit mode, population and employment centers must exist or have reasonable potential to develop in the vicinity. Research suggests that population densities within one quarter to one half mile of a light rail alignment must be at least 3,500-4,000 persons per square mile. In other cases, an existing or expanding employment node may be the source of initial ridership moreso than residential population. Population and employment densities for Alignments B and C are included in Table 7.1. Alignment B has greater population density than does C, while Alignment C has greater employment density than does B.

TABLE 7.1
2000 and 2025 Population and Employment Density

Alignment	Population Density		Employment Density	
	2000	2025	2000	2025
B	3,282	4,180	4,379	5,335
C	2,902	3,919	4,750	5,838

Source: Calculated by LKC Consulting Services, Inc. from H-GAC data

2. **Land Use Pattern.** Land use patterns must be compatible with and supportive of any proposed high-capacity transit option. Features of transit-supportive development include:

   - a relatively high concentration of residents and employees;
   - moderate- to high-density development;
   - mixed uses;
   - pedestrian- and bicycle-oriented and connected;
   - centrally-located development in close proximity to transit;
   - new investment and/or reinvestment;
   - heightened identity; and,
   - enhanced public safety.

   The example of the Mockingbird light rail station in Dallas suggests that as little as 500,000 square feet of non-residential floor space in the vicinity of a rail station is sufficient to achieve a transit-oriented development node that generates significant transit ridership.

3. **Connectivity.** Opportunities for mobility and connections between the community and transit stations must be improved. Specifically, there should be opportunities for making intermodal connections between high-capacity transit, bus, and pedestrian and bicycle systems.

4. **Corridor Character.** Corridor characteristics include features of the area that have an impact on mode selection. Such characteristics include:

   - *Constructability*: Is there adequate right-of-way? Are there environmental constraints or other physical obstacles?
   - *Operations Viability*: Can operations be conducted safely and efficiently? Are there traffic conflicts? What is the potential versus optimal operating speed? What level of ridership might be generated?
   - *Development/Redevelopment Potential*: What development and redevelopment opportunities exist to support high-capacity transit?
   - *Compatibility with the Neighborhood*: Does the mode fit with community plans, needs and image?

Results of Transit Mode Screening

The results of the initial mode screening are presented in **Table 7.2**. Using the four criteria discussed above, this screening attempted to identify "fatal flaws" or overriding reasons why a mode may not be suitable for Inner Katy.

TABLE 7.2
Initial Mode Screening

Mode	CRITERIA			
	Density	Land Use	Connectivity	Corridor Character
HR	X	X		X
CR		X	X	X
AGT		X	X	X
LRT				
BRT				

X = Not Compatible

Source: LKC Consulting Services, Inc. and Inner Katy TOD Study Steering Committee

Heavy Rail (HR) is intended to serve urban areas of very high density, with very high transit demand. With an overall population density of 2,861 persons per square mile in 2000, Inner Katy does not exhibit the necessary characteristics for heavy rail service. Without considering additional development that may result as envisioned through this study, the two rail corridors under consideration are projected to reach population densities of around 4,000 persons per square mile and employment densities of 5,500 jobs per square mile by 2025.

Commuter Rail (CR) is intended to serve longer-distance trips, often operating only during peak hours, with stations several miles apart. The size of the corridor indicates that CR is not likely to provide the best opportunities for mobility and connectivity for the Inner Katy area.

Automated Guideway Transit (AGT) typically provides point-to-point service within a limited area such as an activity center. At present, Inner Katy is not a major activity center, nor will point-to-point service provide the best opportunities for mobility and connectivity. In addition, AGT's futuristic styling may clash with the historic character of parts of Inner Katy.

Although specific challenges exist for each, no fatal flaws were identified for LRT or BRT. These modes are evaluated further in the next section.

Final Mode and Alignment Screening

Similar to the initial alignments evaluation in Chapter 3 and the initial mode screening above, selection of a final HCT mode and alignment was based on particular criteria, including:

- Density
- Constructability
- Operations
- Accessibility/Connectivity

- Compatibility
- Demand

This section concludes with ridership estimates for each alignment.

Density

Both LRT and BRT are corridor-focused technologies that require density and transit demand to be concentrated in areas closest to an HCT alignment and its supporting stations. Therefore, to support a high-capacity mode, the area surrounding transit stations must maintain above average levels of population and employment density. In other words, population and employment densities should be higher than in other areas that might be served by HCT. Also, ridership potential will be greater when the density is focused within a walkable distance, generally one quarter to one half mile.

According to Table 7.1 (based upon H-GAC estimates), Alignment B exhibits greater population densities in both 2000 and 2025 than does Alignment C. However, Alignment C has greater employment density than does Alignment B.

Findings in Chapter 6 (Feasibility Analysis) show that, under the proposed development scenarios, Alignment B would support greater numbers of households and employment than would Alignment C. Generally, a greater number of households within a given area leads to greater population density, and a greater number of jobs equates to greater employment density.

Therefore, in terms of density, Alignment B is superior to Alignment C.

Constructability

Constructability refers to factors that make an alignment or mode more practical for design and construction. These factors include:

- Right-of-way
- Environmental constraints
- Grade separations
- Capital cost

Right of Way

In general, LRT requires a 50-foot cross section for bi-directional operations (25 feet for one-way operation). Research suggests that BRT requires approximately 30 feet for bi-directional operation (15 feet for one-way operation). However, the desirable cross section for BRT may be wider if BRT is to operate in its own exclusive right-of-way (as opposed to operation on arterial streets). Although LRT and BRT can operate in narrower cross sections, these dimensions are preferred in terms of design. Along with the space required for operations, side or center platforms at stations will require at least 10 feet of additional width.

The primary rights-of-way or streets on which HCT would operate along Alignments B and C are shown in **Tables 7.3** and **7.4** along with the available widths.

TABLE 7.3
Alignment B Available Right-of-Way

ROW/Street	Cross Section
MKT Rail Line	50’
Yale	70’
Washington	70’
Allen/Rail Line	25’ +
Houston	160’

Source: City of Houston and LKC Consulting Services, Inc.

TABLE 7.4
Alignment C Available Right-of-Way

ROW/Street	Cross Section
Washington	70’
Center	25’- 40’
Houston	160’

Source: City of Houston and LKC Consulting Services, Inc.

These tables show that both alignments appear to have adequate width to support either mode. However, the impact of LRT or of BRT (operating in an exclusive right-of-way) on Alignment C is likely to be greater than on Alignment B as it would require the elimination of some lanes of existing vehicular traffic on a primary thoroughfare (Washington) that is already experiencing very heavy traffic volumes. In addition, Alignment B has the advantage that a portion of its right-of-way (along the MKT rail line) is owned by the Texas Department of Transportation, perhaps facilitating right-of-way acquisition and associated expenses.

Environmental Constraints

Both alignments must cross Buffalo Bayou in order to enter downtown. In addition, Alignment B crosses White Oak Bayou in two locations – between T.C. Jester and Durham and along Yale. These crossings could require bridge construction or reconstruction or may indicate that flooding could be of concern. The number of crossings will impact construction costs. The more grade crossings, the larger the capital expense. Alignment C does not cross White Oak Bayou.

Grade Separations

LRT and BRT operating in an exclusive right-of-way both require grade separations at rail crossings. The number of grade separations impacts construction costs. The

more grade separations, the larger the capital expense. BRT operating on arterial streets usually does not require grade separation.

Alignment B requires two grade separations over rail – near the Washington/Hempstead split and at the point the alignment crosses the rail line north of Washington from Yale. Alignment C requires one grade separation near the Washington/Hempstead split. In addition, grade separations may be required where either alignment crosses a street with very high traffic volumes. As part of the METRO Mobility effort, METRO will identify the need for additional grade separations as the need and options for high-capacity transit continue to be evaluated.

Capital Cost

The capital costs required to construct LRT or BRT along both alignments was evaluated in Chapter 6 (Feasibility Analysis). Average cost per mile for the METRO CBD-to-Dome LRT line is $43.2 million. Average cost per mile for BRT varies depending on operational characteristics (exclusive right-of-way versus arterial operation). When operating in an exclusive right-of-way, BRT costs $13.5 million per mile on average. When operating on street, the cost is $680,000 per mile.

Table 7.5 summarizes estimated capital expense for each mode and alignment. BRT is significantly less expensive than LRT. This is due, in large part, to the electrification needs associated with LRT.

TABLE 7.5
Capital Cost Estimate
(Millions)

Alignment	LRT	BRT (exclusive ROW)	BRT (arterial)
B (7.5 miles)	$324	$101.25	$5.1
C (7 miles)	$302.4	$94.5	$4.8

Source: Calculated by LKC Consulting Services, Inc. and TIP Development Strategies based on data from GAO and METRO

In terms of right-of-way, Alignment B has advantages over Alignment C. With regard to grade separation and environmental constraints, Alignment C has an advantage, requiring fewer bayou crossings and grade separations. And, as Alignment C is shorter than Alignment B, it is likely to be less expensive to construct. However, this advantage could be offset by the Texas Department of Transportation's current ownership of right-of-way along portions of Alignment B.

BRT is less costly than LRT. However, there is no clear alignment winner in terms of constructability. Either mode could be constructed in either of the alignments depending on the availability of funds.

Operations

Operations refers to factors that make an alignment or mode more practical for the provision of transit service. Such factors include:

- Traffic conflicts
- Sharp turns
- Speed
- Integration with existing systems
- Operating cost

Traffic Conflicts

Both alignments would have an impact on traffic in the Inner Katy area. Vehicle lanes along portions of the alignments would need to be eliminated to accommodate LRT or BRT operating in its own exclusive right-of-way. To maintain reasonable speeds, even BRT operating on arterial streets would require some limitation of lane use by private and commercial vehicles. In addition, traffic patterns would be impacted during the construction phase of any HCT project.

As noted earlier in this chapter, because Alignment C would have high-capacity transit operating within the right-of-way of a high-volume traffic corridor (Washington), it would have a greater impact on traffic than would Alignment B, which, to a larger degree, would operate away from vehicular traffic. In addition, Alignment C would require special design to avoid impacting traffic flow around the planned Washington-on-Westcott roundabout.

The impact of HCT at at-grade crossings can be mitigated through the use of signal priority or preemption systems. These systems create a safer environment and help to maintain transit speeds.

Sharp Turns

Sharp turns along an alignment usually impede the speed of high-capacity transit. Both alignments include rather sharp turns at Houston Avenue where the alignments turn to enter downtown. Alignment B has two additional sharp turns – turning toward and away from Yale. The impact of these two turns, however, may be mitigated by the fact that Alignment B speeds would be less affected by vehicular traffic.

For LRT and BRT operating in an exclusive right-of-way, a second consideration is that navigation around curves requires a minimum radius – generally at least 750 feet. Existing development around the sharp turns on both alignments may hinder the ability to achieve the required turning radius. Therefore, additional right-of-way may need to be acquired in these locations.

Speed

To a large extent, the speed of high-capacity transit depends on distance between stops and the degree to which the transit mode has an exclusive guideway. In general, the fewer the stations and the more exclusive the guideway, the greater the speed. Similarly, because BRT on arterial streets operates in mixed traffic, it may not attain the same speeds as LRT or BRT operating in an exclusive right-of-way.

METRO estimates that its CBD-to-Dome LRT line will operate at an average speed of 17 miles per hour in mixed traffic. Alignment C would operate in a similar mixed-traffic environment. Alignment B may achieve a slightly higher speed due its use of existing rail right-of-way for a portion of its length.

Assuming seven stations along each alignment and average operating speeds of 17 miles per hour for Alignment C and 18 miles per hour for Alignment B, the estimated travel time from the Northwest Transit Center to the Houston Avenue station is presented in **Table 7.6**. This calculation includes station dwell time and traffic signal delay at stations.

TABLE 7.6
Travel Time

Alignment	Travel Time (NWTC to Houston Ave.)
B (7.5 miles)	24 minutes
C (7 miles)	23 minutes

Source: Calculated by LKC Consulting Services, Inc., based on data from METRO

Although Alignment B may operate at a faster average speed, its length (one half mile longer than Alignment C) results in an overall longer travel time.

Integration with Existing Transit

Currently, METRO operates BRT-like services on its freeway HOV lanes. In addition, METRO applies BRT principles through the use of dedicated bus lanes and traffic signal priority in major activity centers such as downtown. However, METRO does not operate high-capacity BRT in exclusive rights-of-way as proposed for Inner Katy. The integration of a new transit mode into the METRO system may be more complex than the integration of additional mileage of an existing mode (bus or LRT).

Integration of additional LRT service would require considerations such as how to accomplish transfers between lines downtown and possibilities for interlining new LRT lines. METRO will be addressing these complex issues as part of its *METRO Mobility* efforts.

Integration of either a BRT or LRT mode would require METRO bus operations to be restructured to provide feeder support and intermodal transfer opportunities.

Interlining is the joining together of routes to facilitate the interchange of passengers between one or more bus lines, rail transit lines or railroads.

Feeder support is when a bus route provides local service that is focused on a transit center to facilitate transfers and to feed and distribute rider to and from other routes.

Operating Cost

The cost to operate LRT or BRT along both alignments was evaluated in Chapter 6 (Feasibility Analysis). Average cost per mile for LRT is $13.25. Average cost per mile for BRT varies depending on operational characteristics such as all-day service versus only during peak periods. An average cost per mile is $3.96.

Table 7.7 summarizes estimated operating expense for each mode and alignment. Total operating cost is primarily a function of alignment length, so Alignment B shows a slightly higher operating cost since this alignment is one-half mile longer than Alignment C. Regarding mode, BRT is generally less expensive to operate than LRT.

TABLE 7.7
Operating Cost Estimates

Alignment	LRT	BRT
B (7.5 miles)	$99.38	$29.70
C (7 miles)	$92.75	$27.72

Source: Calculated by LKC Consulting Services, Inc. and TIP Development Strategies based on data from GAO and METRO

In terms of traffic conflicts, Alignment B has advantages over Alignment C. With regard to sharp turns and speed, Alignment C has an advantage, having fewer sharp turns and being a shorter alignment. As Alignment C is slightly shorter than Alignment B, it would be less costly to operate on a per-mile basis. In terms of operations, Alignment C has somewhat greater advantage over Alignment B.

Accessibility/Connectivity

Pedestrian and Bicycle Linkages

Pedestrian and bicycle linkages complement high-capacity transit by improving mobility and providing intermodal opportunities. As development occurs and high-capacity stations are sited, direct linkages should be established between the high-capacity mode and pedestrian and bicycle routes, lanes and paths.

Some pedestrian amenities currently exist along Alignment C. Because portions of the alignment were originally designed for rail use, Alignment B currently has fewer pedestrian amenities. Regardless of the current presence of amenities, as high-capacity transit is constructed significant improvements to pedestrian facilities will be needed along both alignments.

A Rails-to-Trails bikeway is proposed along portions of Alignment B between T.C. Jester and Yale. The parallel transitway and bikeway could be designed to strongly complement one another. Similarly, Alignment C parallels existing bike lanes on Washington. This bike route is to be extended all the way to Memorial Park, providing strong opportunities for bicycle and HCT integration.

Intermodal Connections

As mentioned above, strong opportunities exist for intermodal connections on both alignments between high-capacity transit and bicycle and pedestrian routes. Both alignments also offer significant opportunities for connections to other METRO services.

Both alignments are anchored on the west by a station at the Northwest Transit Center. The Northwest Transit Center is already an intermodal facility, providing connections between bus and commuter bus services. The addition of LRT or BRT services to this facility will improve local and regional mobility.

Downtown Houston is a major hub for METRO's primarily radial bus network. Both HCT alignments travel into downtown Houston, and both are likely to cross the CBD-to-Dome LRT line.

In terms of accessibility and connectivity, both alignments display high levels of potential. In addition, both modes can be designed to take advantage of that potential.

Compatibility

Compatibility refers to factors that make an alignment or mode more suitable for Inner Katy versus another potential corridor. Such factors include:

- Land use and development suitability
- Neighborhood impacts
- Community needs and preferences

Land Use and Development Suitability

Historically, bus service has a negative image when compared to rail service. The public sees rail modes as faster, quieter and less polluting than bus modes. Transit-oriented development (TOD) has also been primarily focused on rail modes.

Improvements in technology and operations have led to the design of bus modes, like BRT, that can operate just as quickly, quietly and cleanly as rail modes. In cities such as Cleveland, development is occurring along corridors in anticipation of BRT implementation.

Today, BRT and LRT are both compatible with transit-oriented development and the land use patterns TOD creates.

Chapter 6 (Feasibility Analysis) examined the economic potential of each alignment. This potential is independent of mode, meaning the potential exists regardless of the selection of either LRT or BRT. The analysis determined that the development scenario for Alignment B offered greater economic potential than did the scenario for Alignment C. Therefore, Alignment B may provide Inner Katy with the greatest economic benefit.

Neighborhood Impacts

Alignments B and C are undergoing further consideration by METRO as part of *METRO Mobility 2025*. As alignments are evaluated, the local impacts of the need for right-of-way will be considered. Should additional right-of-way be necessary, it would be acquired from property owners along the route. It is likely that either alignment would require that METRO purchase additional right-of-way.

Given the nature of existing development, Alignment C has the potential to cause a larger degree of disruption to local business than does Alignment B. As mentioned earlier in this chapter, Alignment C would also pass by the planned Washington-on-Westcott roundabout. An advantage of Alignment B is that it passes through many areas (along the MKT rail line) that are still largely undeveloped. Alignments B and C both pass near the Old Sixth Ward Historical District. This proximity could have both positive and negative implications. In terms of neighborhood impact, Alignment B may affect Inner Katy neighborhoods and businesses to a lesser degree than would Alignment C.

Community Needs and Preferences

As part of this study effort, members of the project Steering Committee were asked to help identify local issues and concerns relevant to high-capacity transit for Inner Katy. Key issues and concerns were:

- Deteriorating air quality
- Increasing traffic congestion
- Desire for more reliable transit service to downtown and other major activity centers
- Desire for multiple transportation options
- Integration of transportation modes – high-capacity, bus, bike, and pedestrian
- Safety on and around a high-capacity transit system
- Maintaining the area's historic character
- Concern for the displacement of residents and local businesses
- Coordinating with on-going projects such as the Washington-on-Westcott Roundabout, Rails-to-Trails, Tax Increment Reinvestment Zone (TIRZ) projects, etc.

These issues mirror many of the criteria and factors that were reviewed for this chapter.

In addition to the locally identified issues and concerns, METRO has completed its own preliminary investigation of Inner Katy transit needs. Among METRO's findings:

- Existing transit service levels may not be adequate to serve future transit need and demand.
- Alternative transportation modes may help to alleviate roadway congestion.
- Internal circulation within Inner Katy is not well-served by existing transit services.
- Inner Katy could benefit from a neighborhood or community transit facility, providing both internal and external connections.
- Faster, more direct connections to major activity centers is desirable.

Community input clearly indicates the need for some form of improved transit services. Steering Committee members were asked to voice their preferences for a particular transit mode and alignment. The majority preference at the committee's fourth meeting was for LRT along Alignment C. However, the committee did recognize that final mode and alignment decisions must be made based upon a wide range of data and factors.

Demand

Potential transit demand was measured for each alignment based upon the number of transit attractors and generators that would be located within walking distance (one half mile) of stations. The basis for this estimation was the square footage of each unit of development as proposed for Alignment B and Alignment C. The methodology used to generate the estimate is summarized as follows:

- For each HCT station, those parcels within a half-mile radius were selected.
- A query was run for each building use type to sum the total square footage by type surrounding each proposed station.
- Resulting totals were multiplied by vehicle trip generation rates (derived from the *Institute of Transportation Engineers Trip Generation Reference Guide*, Sixth Edition) to estimate average daily vehicle trips for the area surrounding each station.
- The calculated number of average daily vehicle trips was multiplied by H-GAC's regional average vehicle occupancy rate of 1.25 persons to produce average daily person trips for the area surrounding each station.
- A transit capture rate of 1.65 percent was applied to determine the average daily transit ridership that might be generated by the area around each station.

The results of the demand analysis are presented in **Table 7.8**. Note that transit demand was estimated irrespective of mode, assuming maturity of development. Therefore, it is assumed that demand will be generated regardless of the mode choice and that transit demand reflects the contribution of mature development within one half mile of each proposed high-capacity station. This estimation does not consider demand that would result from an Inner Katy HCT line being a

segment in a larger integrated METRO high-capacity system. Nor does it consider demand that would be generated outside of the half-mile area surrounding stations. In addition, some transit demand may be satisfied by bus service operating within the half-mile radius of each HCT station.

TABLE 7.8
Daily Transit Demand Estimate

Alignment	Demand
B	9,400
C	3,900

Source: Calculated by LKC Consulting Services, Inc. based on data from TIP Development Strategies, ITE, and H-GAC

These estimates show that Alignment B generates much higher transit demand than does Alignment C.

Final Transit Alignment and Mode

The result of the final alignment selection, which favors Alignment B, is summarized in **Table 7.9**. An "X" indicates the more favorable alignment for each evaluation category based upon the information presented in this chapter. The lack of an "X" under a particular criterion indicates a neutral rating (each alignment has both positive and negative aspects that offset one another).

TABLE 7.9
Final Alignment Screen

Alignment	CRITERIA					
	Density	Constructability	Operations	Accessibility/ Connectivity	Compatibility	Demand
B	X				X	X
C			X			

Source: LKC Consulting Services, Inc.

The preference for Alignment C that was expressed at a meeting of the project Steering Committee was also taken into account. However, the ultimate alignment recommendation must necessarily be based on technical and feasibility considerations.

The criteria used in selection of a final alignment also have bearing on the selection of a final mode, particularly with respect to the discussions earlier in this chapter about right-of-way, capital cost and speed. However, the primary factors that must be taken into consideration in selecting a final mode are demand and system integration.

The demand estimates indicate that LRT investment may be warranted for Inner Katy. In addition, Inner Katy's proximity to downtown and other activity centers makes it an important piece of any proposed regional HCT system. Without Inner Katy, the effectiveness of the system may be greatly diminished.

As part of *METRO Mobility 2025*, Inner Katy will be evaluated not only in terms of its individual demand potential but also as a link in connecting the entire METRO service area. High-capacity transit in Inner Katy may link to or be interlined with HCT serving Outer Katy, State Highway 249, the Harrisburg area, or other corridors. The potential to be gained from a broader system will be fully evaluated by METRO.

In support of this study, METRO provided an initial list of example technical, engineering, operational, design and cost issues that will impact the final selection of appropriate transit improvements for Inner Katy:

- Service impacts and design/cost constraints associated with grade separating at railroad crossings and at heavily congested intersections.
- Impacts of operating LRT or BRT at-grade in street right-of-way on traffic flow and parking in the area.
- Impacts of speed constraints and transit stop spacing on travel speeds and delivery of transit service at-grade within street right-of-way.
- Differences in ridership potential of proposed Inner Katy alignment alternatives.
- System connectivity and operations between the Inner Katy Corridor and other regional transit corridors.
- Impacts of proposed Inner Katy alignment alternatives on overall transit system operations.

Final Transit-Oriented Development Scenario

Two Final Scenarios

Two final development scenarios were created as a result of this study. The scenarios represent the combined input of workshop participants, the project Steering Committee and the feasibility analysis in Chapter 6. The final scenarios consist of one scenario for Alignment B and one scenario for Alignment C.

A majority of the project Steering Committee identified Alignment C as their final scenario and alignment choice. However, the feasibility analysis determined that Alignment B would be better suited for transit investment and the associated TOD potential. This was due in part to redevelopment opportunities and infrastructure costs and practicability given the existing corridor characteristics. In this chapter, both the B and C scenarios are presented.

The final scenarios were developed through a community visioning process. Participants designed their image for the future of the Inner Katy neighborhoods,

factoring HCT into the development equation by showing on a map where they wanted transit stations and where and what kind of adjacent development was desired. The workshop maps were turned into four initial design scenarios, which then underwent a feasibility and redevelopment analysis. Discussion by the Steering Committee of these initial scenarios resulted in the final scenarios for each alignment.

Observations on Final Scenarios

The final scenarios represent only a concept of how the Inner Katy neighborhoods could transform and develop with the addition of a light rail line. Light rail lines increase an area's accessibility and convenience for residents as well as potential employees and retail customers. This, in turn, allows higher density development, especially around transit centers.

The scenario designs are based on the concepts of transit-oriented development (TOD). TODs concentrate high-density, mixed-use development within walking distance (usually one-quarter to one-half mile) of transit centers. Beyond walking distance, densities start to decrease, but development patterns remain efficient, allowing residents and employees the option of biking, riding a bus or finding other alternative modes of travel to and from the core of the TOD.

Both final scenarios propose seven transit stations, approximately one mile apart. This spacing permits a high level of accessibility to light rail but does not significantly slow travel times for through passengers.

Final Scenario for Alignment C

Alignment C, shown in **Figure 7.1**, primarily follows Washington Avenue. Washington's narrow corridor poses a potential problem for two-way light rail operation due to possibly inadequate right-of-way to accommodate LRT plus multiple lanes of vehicular traffic. Therefore, the final scenario for Alignment C envisions a split track, with one line running farther north but parallel to Washington along Center Street. This split track provides a great opportunity for additional high-density walkable development between the two sections of the transit alignment. **However, it should be emphasized that while the scenario depiction presented here incorporates this one-way pair alignment concept, further discussions near the end of the study process indicated there is very low likelihood of METRO ever designing or constructing a split transit alignment in the Washington Avenue vicinity for the reasons noted earlier in this chapter.**

Two park blocks are showcased in the Alignment C design. Park blocks are attractive boulevards with a strip of park running down the center. The park blocks are flanked with civic structures, plazas, fountains and mixed-use buildings, providing a pleasant environment for the pedestrian and motorist alike.

This scenario offers a variety of office, residential, civic and retail uses, with most of the high-intensity development located near the northwestern transit station, as shown in Figure 7.1. This area, now mostly vacant or industrial land, has vast

potential for housing and employment density. The mixture of high-, mid- and low-rise structures does not overwhelm the pedestrian with a sea of tall buildings. In areas further from transit stops, development is moderately dense townhouses and live/work units. The scenario shows how urban development can be pedestrian friendly and human-scaled. In addition, the corridor provides plenty of "people places." Civic spaces encircled by small parks and green corridors can create a series of accessible open spaces in a dense urban setting.

Residential neighborhoods adjacent to the corridor will benefit from their close proximity to transit. However, they will not be greatly impacted by redevelopment activities. The scenario design recognizes existing stable residential neighborhoods and buffers them with low-density residential development.

Final Scenario for Alignment B

Alignment B, shown in **Figure 7.2**, is the favored corridor based on initial feasibility analysis. **(It should be noted that Figure 7.2, as well as the alignment map on page 7-1, depict Alignment B before it was adjusted to shift the turning point along Yale from 7th to 6th Street. The portion west of Shepherd-Durham returns to the 7th Street alignment.)** Alignment B has more vacant land, less disruption to businesses during transit construction, and offers the prospect for improving the connection between the northern and southern parts of the study area on either side of the Katy Freeway corridor. Alignment B also has the necessary width to more easily accommodate light rail. Although the scenarios represent significant change near transit stops, at buildout the development depicted would constitute less than two percent (1.74%) of the projected household growth for 2025 in Harris County.

The corridor is an assortment of high-rise, mixed-use transit centers, plazas, pedestrian shopping districts and a waterfront park. Like Alignment C, the scenario splits the light rail track along Washington Avenue. Although a smaller segment of the corridor is split, it still offers many opportunities for walkable shopping and business districts.

One of the most appealing design elements in scenario B is the development of an open space and trail system. White Oak Bayou provides a unique opportunity for open space development. The scenario proposes a greenway that would allow residents to walk or bike along the bayou from Old Katy all the way down to Glenwood Cemetery. The trail would provide needed open space while preserving the bayou's natural beauty. A number of plazas and civic spaces would act as gateways for the greenway where it meets transit stations and adjacent development.

Implementation Strategies

Implementation of Transit-Oriented Development (TOD)

For TODs to work, they must have the following basic ingredients:

- Development that is intense enough to support retail for the residents and employees who live and work at the TOD as well as the transit riders who utilize the station.
- Buildings set close to the sidewalk to minimize walking distances and create a pleasant pedestrian environment. (Walkers prefer to walk next to a defined boundary such as a row of buildings, especially if the buildings are active and interesting, containing lively uses such as shops, daycare, schools, lobbies or public-oriented office uses.)
- Parking that is hidden from pedestrian routes and minimized through shared parking strategies.
- Street and walkway connections to the adjacent community, inviting surrounding residents to walk to the TOD to ride transit and utilize the shopping or employment options the TOD offers.
- Amenities and design to create a high quality environment that acts as a neighborhood center for the surrounding community.

Planning for Walkability

The most effective method for creating pedestrian-friendly districts is to use a three-pronged approach to implementation: (1) regulation, (2) public infrastructure, and (3) partnerships between private organizations and public agencies. Regulations are tools that shape the form of private investment, such as the location of buildings and parking, the form and size of buildings, and basic design features such as the size and location of a garage door. Regulations can affect the likelihood that development will occur where it is wanted and can discourage incompatible development. However, regulations alone do not directly alter the built or natural environment.

On the other hand, public investments are direct expenditures that change the form of the built or natural environment, such as changes to the street right-of-way. Public investments can improve an area single-handedly and can also change the climate in which private decisions are made.

Partnerships involve a sharing of efforts, money or expertise between a local government and either another governmental agency, a business entity or private person, or a nonprofit organization. Partnerships can accomplish a wide array of goals, such as developing the land, providing pedestrian amenities and street improvements, and ensuring adequate housing near a business district.

Basic Characteristics of Pedestrian-Friendly Commercial

Successful commercial developments that rely on walk-in traffic – whether main streets, entertainment districts, downtowns or other pedestrian-friendly districts – are dependent on several key elements for their success:

1. **Designs That Attract Shoppers.** For this reason, shop windows are crucial, as is the concentration of shopping opportunities along the pedestrian paths. Shop fronts display their most tantalizing merchandise, and displays change every 25 feet or so to create an ever-changing rhythm of goods.

2. **Presence of Other Pedestrians.** The presence of other people is an attraction and helps to foster a safer environment. This is the opposite of auto-oriented design, where the goal is to be a solitary driver.

3. **Higher Density of Smaller Shops.** The best pedestrian areas have a higher density of shops, each of which is smaller than the typical auto-oriented prototype. Even a large establishment within a pedestrian area, such as a department store, must have display windows that follow the smaller format's rhythm. Because these many small stores depend on the health of the entire shopping environment, a certain "mass" of stores is required, unlike small neighborhood stores that can exist in isolation. Therefore, the business district as a whole frequently uses a common strategy to lure shoppers into the area rather than relying only on each store's advertising efforts.

4. **Never Locating Parking Between Building Entrances and Pedestrians.** Because of the emphasis on creating a pedestrian environment, parking is along the street or in common parking areas in lots or structures that do not disrupt the pedestrian environment. The concept is to provide a convenient location where shoppers can leave their cars and get to areas for walking as soon as possible. The parking areas tend to be fairly inconspicuous, and the amount of parking supplied is usually less with a much more customized approach to the amount needed.

Designing for Redevelopment

Changes such as street improvements or modified development regulations can alter a site's surrounding characteristics over time. Therefore, it is often beneficial to plan for a higher level of walkability than the site currently supports.

Parking lots can be organized in a grid pattern with street right-of-ways in order to accommodate future pedestrian-oriented development that would redevelop portions of the surface parking.

Design Opportunities and Preferences

Toward the conclusion of this study, Steering Committee members participated in a design preference survey exercise in which they viewed and rated a series of images to determine which are most consistent with the desired development patterns and styles for potential HCT corridors and station areas. The survey results provided

direction to the consultant team for creating new images to depict corridor redevelopment opportunities. The results also offer a flavor of the community's vision for its future relative to transit-oriented development.

During the exercise, each image was assigned one to five points, with five points indicating the most positive reaction. Committee members also quickly checked what they liked or did not like about each image in terms of Architecture/Style, Compatibility, Building Materials, Landscaping, Scale, all of the above, or other factors. Of the 115 images assessed by the survey participants (on file with the City of Houston Planning & Development Department), 58 images scored "above average." The point totals of these 58 positive images were allocated as shown in **Table 7.10**. With 45 the maximum possible point total, none of the images scored higher than 40.

TABLE 7.10
Highest-Rated Design Preference Images

Scoring Range	Number of Images
22-25 points	28
26-30 points	19
31-35 points	8
35-40 points	3

Source: Webb Architects

Among the 58 images receiving the committee's highest rankings, 12 highlighted all four of the key elements in "placemaking":

1. Accessibility
2. Activities
3. Comfort
4. Sociability

The most positively-received images included such elements as:

- more densely developed single-family dwellings;
- townhomes;
- combination live/work units;
- more compact shopping areas;
- mixed residential/ commercial districts with generous on-street parking;
- various types of pedestrian amenities (wide sidewalks, pedestrian bridges over busy roadways, high-profile crosswalks);

- zero-setback buildings lining streets (both residential structures and retail storefronts);
- parking garages incorporated into new buildings through creative design; and,
- public spaces (fountains, outdoor seating, linear parks, public art).

In preparing to sketch images of the community's design preferences, the consultant team interpreted the visual survey results as pointing toward the following principles:

- Capture the texture and variety of the neighborhoods and revitalize their image.
- Remember and formalize the critical transition from the corridors into the neighborhoods.
- Emphasize the public realm.
- Capture the potential of new development along future high-capacity transit corridors.

Four preliminary sketch images were then created to illustrate how Inner Katy neighborhoods could change or be enhanced as a result of transit-oriented development influences.

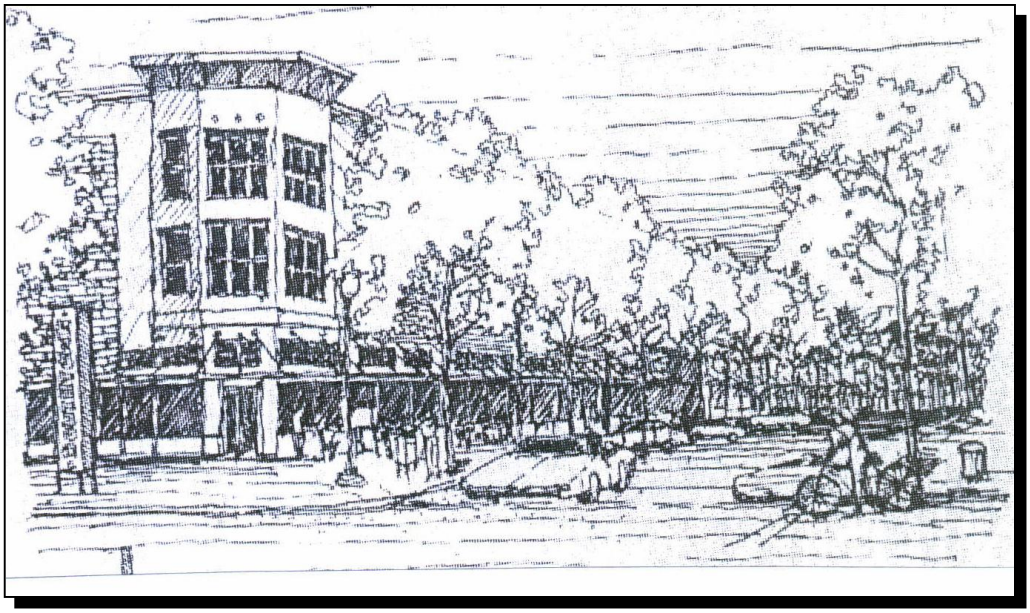


IMAGE 1:
Regaining tree cover and improving the public realm – the sidewalk.

SOURCE:
Webb Architects

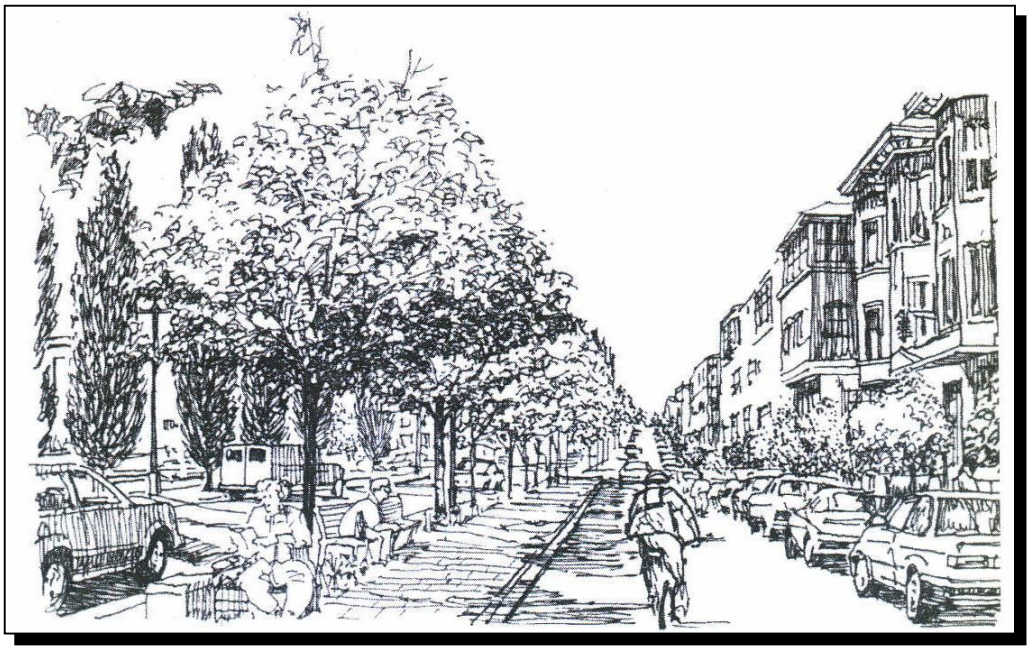


IMAGE 2:
Multi-use pattern with housing close to a boulevard or streets plus the potential for incorporating a transitway among the tree-lined way.

SOURCE:
Webb Architects

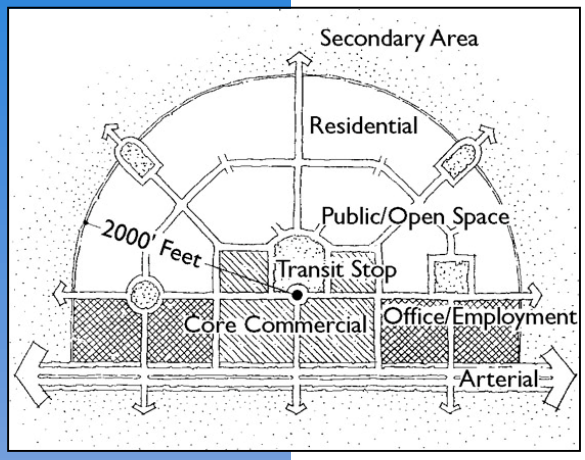
IMAGE 3:
New or rehabilitated structures to create new public spaces such as old manufacturing facilities transformed (e.g., in the west end of the corridor).

SOURCE:
Webb Architects

IMAGE 4:
Recreate, create and incorporate new neighborhood social spaces – parks and housing.

SOURCE:
Webb Architects

The following additional design principles and features are critical elements of successful TOD efforts:

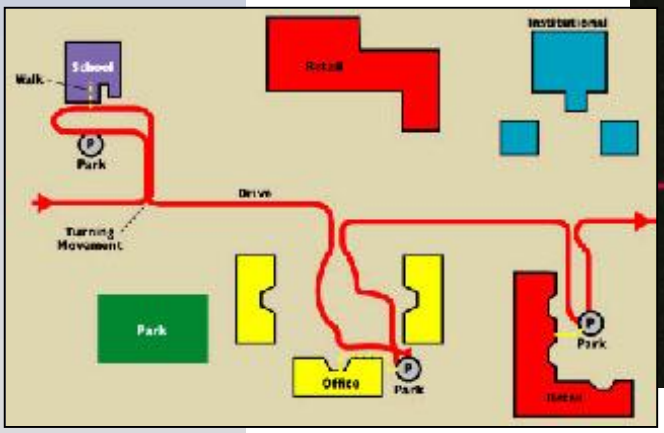


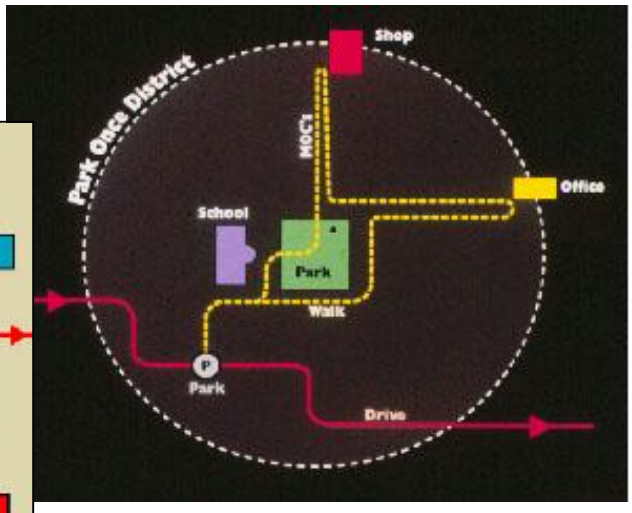
1. **Walking and Transit Use Go Hand in Hand.** Design characteristics that increase walking include convenience, a pleasant environment, and attractive and interesting surroundings. Convenience is enhanced through mixing of uses and more compact development to increase walkable destinations. Practical destinations, such as a neighborhood-scale supermarket, are also essential.

2. **Density Alone Is Not Good Enough.** Increased development density by itself does not change travel behavior or create a desirable area. Design is important. Density must be coupled with pleasant and attractive settings and human scale in buildings and spaces. Particularly in Texas, relief from heat and sun is also a must and can be created through ample trees and shade, storefront awnings, covered sidewalks, and water features.

3. **Parking Arrangements Must Encourage Walking.** In an auto-oriented district, one car uses 3-5 parking spaces in the course of a day. More walkable areas are "park once" districts, where various daytime errands can be accomplished on foot. Design of parking areas is also important to ensure that they blend with rather than dominate the surrounding district, with appropriate perimeter treatments or landscaping to provide attractive screening and buffering.

Auto-oriented district (below) versus a "park once" district (right).



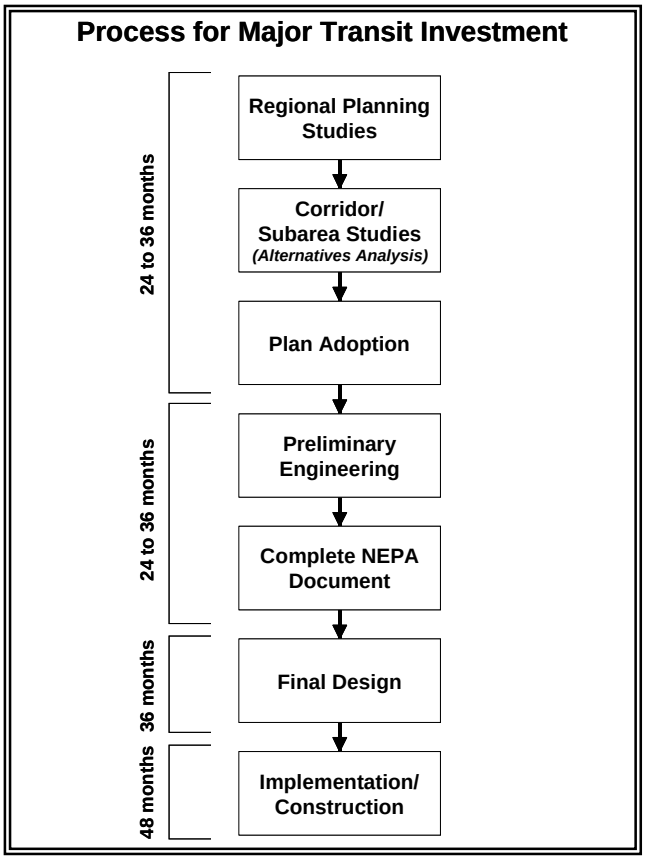


4. **People are the Key.** Maintaining human scale in both buildings and the spaces between them is essential to what TOD is all about – people, accessibility and vibrant neighborhoods. Connections must be made to the adjacent community, inviting surrounding residents.

Transit Implementation

Major capital investments are the result of a locally driven, multimodal transportation planning process. Without a local commitment to facilitate project acceleration, this planning process can take more than 10 years to complete as outlined in **Figure 7.3**.

FIGURE 7.3
Typical Timeline for Major Transit Investment



Source: LKC Consulting Services, Inc. and Dallas Area Rapid Transit (DART)

Necessary steps in METRO's transit investment planning process are as follows:

Planning Studies

On May 24, 2001, the Metropolitan Transit Authority of Harris County (METRO) Board of Directors adopted the 2025 Transit System Plan for Mobility, referred to

as *METRO Mobility 2025*. *METRO Mobility 2025* provides the conceptual framework for transit development in the region over the next 25 years, reflecting a broad approach to enhancing and expanding transit service and facilities throughout the metropolitan area. *METRO Mobility 2025* includes new transit service, expansion of existing operations, introduction of Advanced High-Capacity Transit (AHCT) in a number of travel corridors, and the extension of service to highly populated areas outside the METRO service area.

METRO Mobility 2025 emphasizes the implementation of AHCT in specific corridors, in addition to targeting other transit service and operations improvements inside and outside the current service area. Although not originally identified as one of the specific corridors for initial AHCT development, the Inner Katy Corridor emerged later in the process as an important candidate for improvements to address existing and projected growth and to serve as a connection to downtown. Having been identified as a study area, the Inner Katy Corridor is undergoing a thorough study process by METRO that will:

- define the corridor in terms of geography, population, employment, and travel characteristics;
- document the existing transportation, demographic, and land use conditions;
- involve key members of the public in a series of stakeholder meetings; and,
- provide a set of transit opportunities to recommend for further study, recommendation, and implementation.

Alternatives Analysis

Alternatives analysis is the corridor-level component of the metropolitan planning process. It considers transportation problems, alternative solutions, and the likely costs and benefits of those alternatives, and then identifies a preferred solution.

Preliminary Engineering

Preliminary engineering examines alternative ways of implementing the preferred solution, producing a firm definition of the scope of the project and completing the environmental analysis and documentation for the project.

NEPA Documentation

The National Environmental Policy Act (NEPA) requires broad consideration of the environmental impacts of alternative projects. The result of this analysis is an Environmental Impact Statement (EIS) that must be submitted to the Federal Transit Administration (FTA) for consideration.

Final Design

Final design develops the engineering designs and construction documents, finalizes funding agreements, and prepares the project for construction.

Implementation/Construction

Implementation/construction includes all phases of building and required testing up to the opening of the project for public use.

Over roughly the next year through August 2003, METRO will follow the general process and timeline outlined below for refining its Inner Katy plans as part of the overall *METRO Mobility 2025* plan:

Through February 2003

- Complete the Inner Katy Corridor Transit Study (assessment of transit needs and identification of alternative transit improvements).
- Complete all other *METRO Mobility 2025* corridor studies.

February 2003 to April 2003

- Assemble Draft Transit System Plan (system plan with corridor improvements for the metropolitan region).
- Draft Transit System Plan presented to METRO Board in April 2003.

April 2003 to June 2003

- Conduct widespread outreach to obtain community feedback and comment on the Draft Transit System Plan.
- Refine System Plan.
- Forward Revised Transit System Plan to METRO Board in June 2003.

July 2003

- METRO Board adopts 2025 Transit System Plan.

August 2003

- Conduct detailed Inner Katy Corridor Review (initiate detailed review to prepare for next phase of corridor development and refinement).

APPENDIX A: Transit Funding Options

This Appendix describes funding options for public transportation improvements in the Inner Katy area.

Federal Sources

Federal funding for public transportation (transit) comes through the U.S. Department of Transportation (USDOT). Other federal departments also have funds available that can be used for transit if transportation benefits the main purpose of the department, such as improving access to work or improving economic development.

The programs and funding for public transportation from the USDOT were established in the umbrella legislation known as the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991. ISTEA established authorized funding levels and programs for transit and highway projects and institutionalized the ability to shift funds from one program to another depending upon local priorities. ISTEA expired at the end of fiscal 1997 and was replaced by the Transportation Equity Act for the 21st Century (TEA-21). TEA-21 maintains the previously established programs and generally raises the overall funding levels. TEA-21 is effective for a six-year period, from 1998 to 2003, with specific spending levels established each year as part of the federal budgeting process.

TEA-21 provides funding for the USDOT and its subsidiary agencies, including the Federal Transit Administration (FTA) and the Federal Highway Administration (FHWA).

The FTA funding sources for transit consist of the following:

- Urbanized Area Formula Program (Section 5307)
- Non-urbanized Area (Rural) Formula Program (Section 5311)
- Elderly and Persons with Disabilities Program (Section 5310)
- Discretionary Capital Program Funds (Section 5309)
- Metropolitan Planning Program (Section 5303) and State Planning and Research Program (Section 5313)
- Clean Fuels Formula Program (Section 5308)

TEA-21 also added specific funding programs for new initiatives by either FTA or FHWA, including:

- Job Access and Reverse Commute Program
- Transportation and Community and System Preservation (TCSP)

- Livable Communities
- Flexible Funds

Additional federal funds that can be used for public transit are available from FHWA under the Congestion Mitigation and Air Quality Act (CMAQ) Program. CMAQ funds have been established to further the goals of the Clean Air Act Amendments (CAAA) of 1990 to reduce the levels of air pollution in cities that violate the health standards established by the Environmental Protection Agency (EPA).

Urbanized Area Formula Program (Section 5307)
The major federal funding source for transit is the Section 5307 Urbanized Area Formula Program. The funding levels are based upon a statutory formula and vary based upon the size of the urbanized area. Urbanized areas are grouped into three sizes: small urbanized areas having a population between 50,000 and 200,000, medium urbanized areas having a population between 200,000 and one million, and large urbanized areas having a population in excess of one million.

Non-urbanized Area (Rural) Formula Program (Section 5311)
The FTA provides the State of Texas Section 5311 funds for public transportation services in non-urbanized, rural areas (less than 50,000 population). As Inner Katy is part of a major metropolitan area, it is not eligible to use Section 5311 funds.

Elderly and Persons with Disabilities Program (Section 5310)
Section 5310 funds can be used for a transit service that will benefit the elderly persons and persons with disabilities. Funds can be used to purchase services for the target markets or to buy vehicles to transport the elderly and persons with disabilities. TxDOT awards these funds on a discretionary basis to qualified applicants.

Discretionary Capital Program Funds (Section 5309)
The Section 5309 Discretionary Capital Program provides assistance for establishing new rail transit projects, improving and maintaining existing rail transit and other fixed guideway systems, and providing funding for buses and other bus-related capital projects. Unlike other FTA funding categories that allocate money on a formula basis, Section 5309 funds are awarded on a discretionary basis for a particular capital project. The eligible federal share is 80 percent, but FTA encourages applicants to develop greater non-federal match to secure Section 5309 funding.

Section 5309 funds can be obtained in one of two ways. First, the project can receive an "earmark" with a funding level specified in the transportation legislation (ISTEA or TEA-21) or the annual appropriations. Secondly, projects may receive a discretionary grant on the basis of a competition for funds with all other bus or rail projects in the United States. Individual urbanized areas send applications directly to FTA. However, this program is highly competitive. Typically, Congress earmarks all the available dollars for specific projects. Historically, the State of Texas has

received an earmark for replacement of buses. TxDOT awards these funds on a competitive basis.

Metropolitan Planning Program (Section 5303) and
State Planning and Research Program (Section 5313)
Section 5303 funds are provided to local MPOs through TxDOT for transit or highway planning activities. Section 5313 monies are awarded to TxDOT for statewide transit planning and research activities. Section 5303 funds are administered in concert with the FHWA 112 planning funds Section 5303 and Section 5313 both require a 20 percent state match.

TxDOT receives an annual planning grant from FTA under the Section 5303 program. Rural transit districts are targeted for these funds since they do not benefit from the transit planning funds awarded to MPOs in urbanized areas.

Clean Fuels Formula Program (Section 5308)
The Clean Fuels Formula Program was authorized by TEA-21 to support the purchase or lease of clean fuel buses and facilities and the improvement of existing facilities to accommodate clean fuel buses. Eligible grant recipients are public transportation operators that provide transit in either urbanized or non-urbanized non-attainment or maintenance areas. Non-attainment areas have air pollution levels that exceed the national Ambient Air Quality Standards on a continual basis. Maintenance areas meet the standard but with concern that the standards may be exceeded. Clean fuels vehicles include electric and hybrid-electric buses. The Clean Fuels Program was not funded in fiscal 2000, but rather funds were allocated as part of the capital program for buses (Section 5309).

Clean Fuels is a formula program. The formula is applied on the basis of the grant applications submitted. Grant applications must be submitted by January 1 of each fiscal year. By February 1 of each fiscal year, FTA must apportion funds to the grant applicants. Two-thirds of the funds available are to be apportioned to grantees in urbanized areas with populations of one million and over, and one-third to grantees in areas with populations less than one million. There are limitations within the program on amounts that may be awarded for single grants and for some types of projects.

The Clean Fuels Formula Program began with Fiscal 1999 and is authorized for the remaining five years of TEA-21 (through Fiscal 2003). Funds are available to a project for the year of appropriation, plus one year more.

Job Access and Reverse Commute Grants
The Job Access and Reverse Commute program provides competitive grants for transportation services to connect welfare recipients and low-income persons with employment and support services. Local governments and non-profit organizations designated by states or MPOs are eligible to receive these funds.

A coordinated planning mechanism between transportation providers and human service organizations is required to develop job access programs, and these programs must be approved by transit agencies. Also included in this initiative is a

reverse commute program designed to provide services to suburban employment centers from urban centers, rural areas, and other suburban locations. The reverse commute program provides a 50 percent federal match, with no more than $10 million per year to be used for reverse commute activities.

Grant awards are based on:

- the percentage of welfare recipients in the population;
- the need for additional services;
- coordination with and use of existing transportation providers;
- coordination with state welfare agencies;
- implementation of the Temporary Assistance for Needy Families (TANF) program;
- use of innovative approaches;
- presence of a regional plan;
- long-term financing strategies; and,
- consultation with the communities to be served.

For Job Access/Reverse Commute grants, the primary applicant is the state (TxDOT). TxDOT has responsibility for ranking and administering the Job Access and Reverse Commute program. Beginning in fiscal 2000, all applications from rural transit districts or urban transit systems had to be ranked by TxDOT before being sent to FTA for inclusion in a national competition.

Livable Communities

FTA started the Livable Communities Initiative to strengthen the link between transit and communities. Transit facilities and services that promote more livable communities are ones which are customer-friendly, community-oriented and well designed resulting from a planning and design process with active community involvement.

Eligible recipients are transit operators, metropolitan planning organizations, city and county governments, states, planning agencies and other public bodies with the authority to plan or construct transit projects. Non-profit, community and civic organizations are encouraged to participate in project planning and development as a partner with eligible recipients. Both planning and capital grants are available through this initiative.

Transportation and Community and System Preservation (TCSP)

TEA-21 established an FHWA program to investigate and address the relationships between transportation and community and system preservation and identify private sector-based initiatives.

The purposes of the new program are to improve transportation efficiency; reduce transportation's environmental impacts; reduce the need for future investments in infrastructure; provide access to jobs; and encourage private sector development that supports these initiatives. The program includes a research program to investigate these relationships; funds to integrate Transportation and Community and System Preservation plans and practices; and funds to address transportation efficiency and community system preservation.

Two types of grants are awarded through this program: planning and implementation. Planning grants are designed to research, plan, and develop strategies to meet the purposes of the TCSP. Priority for planning grants is given to applicants that demonstrate a commitment of non-federal resources to the proposal, including involvement of nontraditional partners. Implementation grants are designed to carry out projects that meet the purposes of the TCSP. Priority for implementation grants is given to applicants that promote cost-effective and strategic investments in transportation infrastructure that minimize adverse impacts of the environment and promote innovative private sector strategies.

There is no local share requirement under TCSP. Activities are eligible for full federal funding.

Flexible Funds

Flexible funds are certain legislatively specified funds that may be used either for transit or highway purposes. This provision was first included in ISTEA and was continued with TEA-21. The idea of flexible funds is that a local area can choose to use certain federal Surface Transportation Program funds based on local planning priorities, not on a restrictive definition of program eligibility. Since ISTEA, FHWA funds transferred to the FTA have provided a substantial new source of funds for transit projects.

The decision to transfer funds is part of the transportation planning process. Flexible funds designated for use in transit projects must result from the metropolitan and state planning and programming process and must be included in an approved State Transportation Improvement Plan (STIP) before funds can be transferred. To initiate the transfer, the grantee must submit an application to FTA and notify TxDOT that an application has been submitted. TxDOT requests the transfer of highway funds through their FHWA division, which confirms the amount requested is available for transfer, then transfers obligation authority and an equal amount of funds to FTA.

Funds are transferred to one of three FTA formula programs: 5307, 5311, or 5310. The flexible funds are administered as and take on all the requirements of FTA formula funds, although they retain a special identifying code. The funds may be used for any capital purpose eligible under the FTA formula programs

Congestion Mitigation and Air Quality (CMAQ)

Under the Clean Air Act as Amended in 1990 (CAAA), urbanized areas are classified by the EPA as non-attainment areas when air pollution levels exceed the national Ambient Air Quality Standards on a continual basis. Depending upon the

level of pollution and the frequency the standards are exceeded, urbanized areas are classified according to increasing pollution levels as marginal, moderate, serious, severe, or extreme. Marginal is the lowest level of pollution and extreme is the highest. Cities that were classified as non-attainment and subsequently achieved the EPA standards are classified as maintenance. The Houston-Galveston-Brazoria area is in severe non-attainment for ozone.

Congress established the CMAQ program to fund projects that reduce transportation-related emissions. CMAQ is administered by the FHWA nationally. The $1 billion federal CMAQ program provides each state with a minimum of 0.5 percent of total program dollars. Additional monies are allocated to states based upon the population and level of pollution in non-attainment areas within the state. Funds are distributed according to a formula based on population and severity of pollution. The federal share can fund up to 90 percent of transit vehicle-related equipment attributable to compliance with CAAA, up to 80 percent of other capital projects, and 80 percent of the operations costs for demonstration of services. Demonstration projects can be funded for up to two years. CMAQ funds can be applied to either highway or transit projects.

Indirect Sources of Federal Funding

Options for the provision of coordinated transportation and transportation for persons with disabilities are available as part of social service programs that have been historically focused on providing client-based transportation services. Social service programs through the United States Department of Agriculture (USDA), Department of Education (DOE), Department of Health and Human Services (DHHS), Housing and Urban Development (HUD), and Department of Labor (DOL) include transportation as a required element in delivering the agency's primary services. These program funds are typically allocated to state agencies that then distribute the funds to local programs. A number of programs exist; the programs listed below highlight those that are most often used to support public transportation in Texas.

Vocational Rehabilitation State Grants

The DOE Office of Special Education and Rehabilitative Services (OSERS) provides vocational rehabilitation funds to state rehabilitation agencies on a formula basis. These funds are intended to help to provide a full range of rehabilitative services, including transportation services.

Independent Living Programs

DOE's OSERS provides funds to support independent living of persons with significant disabilities and to provide technical assistance to help public and non-profit organizations provide independent living services. Transportation to critical services and employment is a key element in providing independent living for persons with disabilities.

Medicaid

Medicaid is the largest source of funding for medical and health-related services for America's poorest people. Title XIX of the Social Security Act is a federal-state matching entitlement program that pays for medical assistance for certain vulnerable

and needy individuals and families with low incomes and resources. This program, known as Medicaid, became law in 1965 as a jointly funded cooperative venture between the federal and state governments to assist states in furnishing medical assistance, including related transportation expenses, to eligible needy persons.

Within broad national guidelines established by federal statutes, regulations and policies, each state: (1) establishes its own eligibility standards; (2) determines the type, amount, duration, and scope of services; (3) sets the rate of payment for services; and (4) administers its own program. Medicaid policies for eligibility, services, and payment are complex, and vary considerably even among similar-sized and/or adjacent states. Many urban transit systems and rural transit districts in Texas have entered into contracts to provide Medicaid transportation.

Temporary Assistance for Needy Families

Temporary Assistance for Needy Families (TANF) block grants are made available by DHHS to the states, as authorized by Section 401 of the Social Security Act. TANF funds provide assistance to needy families to:

- Care for children in their own homes or in the homes of relatives.
- End the dependence of needy parents on government benefits by promoting job preparation, work, and marriage.
- Prevent and reduce the incidence of out-of-wedlock pregnancies and establish annual numerical goals for preventing and reducing the incidence of these pregnancies.
- Encourage the formation and maintenance of two-parent families.

TANF agencies may use TANF funds to provide support services, including childcare and transportation. Among eligible transportation expenses are transit fare reimbursements, contracted transit services, acquisition of transit capital (vehicles), and operation of transit services.

Social Service Research and Demonstration

DHHS provides funds to support demonstrations of innovative strategies for moving people from welfare to work. These strategies can include transportation services.

Community Services Block Grants

DHHS provides states and Indian tribes funds to provide a broad range of social services for low-income persons. These funds include Community Services Block Grants. These funds are awarded on a formula basis to states, which pass the majority of the funds on to nonprofit community action programs. Transportation services are provided by many of these local programs.

Developmental Disabilities Grants

DHHS provides formula grants to state agencies to provide needed social services to help individuals reduce welfare dependency, achieve self-sufficiency, and forestall

unnecessary use of institutional care. These services can include transportation services.

Supportive Housing for Persons with Disabilities
HUD's Office of Housing provides grants to nonprofit organizations to construct or rehabilitate rental housing for low-income persons with disabilities. Grantees are required to address supportive services, including transportation.

Welfare to Work Grants
The Department of Labor (DOL) provides grants to states and local communities to create additional job opportunities for the hardest-to-employ TANF recipients. Allowable expenses include transportation to:

- job readiness programs;
- employment;
- job placement services;
- post-employment services;
- job retention; and,
- support services that are designed to move hard-to-employ welfare recipients into unsubsidized employment.

Welfare to Work funds can only be used for transportation services that are not otherwise available to the participant. Other federal funds may not be used to fulfill local match requirements, except transportation funds as provided by TEA-21. Up to 50 percent of the local match may be provided in the form of third party in-kind services.

Workforce Investment Act Programs
The DOL Employment and Training Administration (ETA) funds programs under the Workforce Investment Act of 1998. As of July 1, 1999, this program combines the Job Training Partnership Act (JTPA) and other federal job training programs into a network of formula grants to states and Indian tribes for youth and adult job training services through local workforce investment areas.

State Sources

Each biennium the Texas Legislature appropriates state funds for public transportation in urban and rural areas. TxDOT administers funds for public transportation.

Public Transportation Fund
The Public Transportation Fund (PTF) supports transit in rural areas and in municipalities not included in a transit authority. As Inner Katy is located in a city with a population of over 200,000 and is part of the METRO service area, it is not eligible for PTF funds.

Toll Revenue Credits for Transit Projects

TEA-21 permits a state to use as a credit toward the nonfederal share requirement toll revenues that are generated and used by a public agency to build, improve or maintain facilities that serve the purpose of interstate commerce. When beneficial and appropriate, toll revenue credits can be used on transit projects.

Local Sources

Local funds for public transportation may be provided through the proceeds of a dedicated local sales tax. Other sources of funds for local share include certain federal block grants, transit generated revenue, in-kind contribution and a variety of private resources.

Local Sales Tax

State legislation provides an opportunity for voters in larger metropolitan areas to establish regional and municipal transit authorities with a dedicated local sales tax for transit. If approved by general referendum, a transit authority can be established to own and operate a public transportation system that is funded by the local sales tax dedicated to transit. The sales tax rate for the METRO service area (of which Inner Katy is a part) is one percent.

Community Development Block Grants

Community Development Block Grants (CDBG) funds originate with the federal Department of Housing and Urban Development (HUD). Unlike most federal funding sources, CDBG funds can be used as a local match to other federal funds. The CDBG program provides annual grants that can be used to revitalize neighborhoods, expand affordable housing and economic opportunities, and improve community facilities and services. Since transportation is considered a service that benefits the target population, CDBG funds can be used to pay local share for public transportation operating and capital costs.

Transit Generated Revenue

Aside from the fare revenues, a transit provider can generate additional revenue as a result of operating transit service. One method of generating revenue is to lease advertising rights on vehicles and at bus stops. Another method is to charter vehicles.

In-Kind Contribution

In-kind contributions may provide a portion of the local funding match. In-kind contributions can include land and building space, such as existing city offices and facilities, for administration and operations. A local jurisdiction can also offer personnel costs and direct expenses as in-kind services.

Private Investment

Financial assistance may be provided by private entities that will benefit from the transit services, such as businesses that will be served by the new transit service. Private investments could include sponsored service or assistance with capital expenses, such as purchasing vehicles or donating land for a transit hub.

Joint Development/Transit-Oriented Development
Transit agencies have begun to have success with joint development projects, where private developers contribute a portion of a project's total cost in return for a long-term lease on a portion of the property under development.

Sponsored Service
Service sponsors can be major retail businesses or developers. Each of these groups can fund a portion of the cost of service for their particular location. Obtaining these funds requires a close working relationship with the sponsor to ensure the service meets their needs. Through their contributions, sponsors can help to fund the operating deficit.

Private Donations
Capital improvements provide an opportunity for public/private partnerships. A private landowner or developer can contribute the land or the capital improvement. The local government can then use the value of the private investment as local share for the capital cost of implementing the transit service.

Tax Increment Financing (TIF)
Tax increment financing is a method local governments can use to finance improvements to support new development or redevelopment of an area. The valuation of property for general tax purposes is frozen within the designated area at a base level at a given point in time. Through the period of the development program, the ad valorem taxes within the development zone derived from the increased property values above the established base are applied directly to the tax increment district to pay for infrastructure improvements or to support the debt service of the bonds for capital improvements. Individual taxing entities continue to receive the base-level tax revenues. Subsequent to the payment of costs associated with the district's capital program, the tax increment district is dissolved and all taxing jurisdictions benefit from the full, increased property values and revenues.

Special Districts
There may be an opportunity to finance public transportation improvements and, in some cases, operation of transportation services with local funds generated from special districts. Typically, special districts are used to finance the capital costs of a single project or a series of projects.

Transportation Management Organization (TMO)
A TMO is a voluntary association created to solve mobility problems in urban and suburban areas. This type of voluntary association is designed to focus on meeting present and future transportation objectives of the area. Unlike an area association or chamber of commerce, a TMO is created to focus solely on mobility issues. Since the focus is limited to mobility, a TMO has a greater ability to become effectively involved in planning and advocating mobility solutions.

The strength of a TMO is the ability to coordinate and receive input from local private sector businesses and property owners. In addition to planning transportation improvements, a TMO can serve as an entity to operate, contract, or broker transportation services such as vanpool or rideshare programs or transit.

TMOs are funded primarily through contributions and dues of members, but they may also be the recipients of grants.

Parking Fees and Fines

Parking fees and fines may be used as a dedicated funding source for transit operations. Revenues from city parking meters and lots may serve as a source of transit operating funds. Parking rates can be structured to increase both parking revenue and transit ridership.

Development Impact Fees

Development impact fees for parking may provide a source of local funds. A parking impact fee could be implemented whereby new buildings along transit routes may elect to pay a fee in lieu of providing some or all of the parking required by local ordinance. The fee can be dedicated to providing transit service to reduce the demand for parking.

Leveraged Leasing

Leveraged leasing is a general term used to describe an asset lease-leaseback or asset sale-leaseback transaction. The process allows an agency (such as a transit agency) to sell the federal tax benefit from depreciation of transit assets to a private entity in exchange for funds that can be used to enhance or expand transit infrastructure.

Grant Anticipation

Grant anticipation involves issuing bonds based on anticipated federal revenues.